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Strength of TROPOMI observations on the retrieval of SO2 emissions at high temporal resolution from space

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The adverse impact of volcanic gas and aerosol emission on global climate, air quality and ecosystem is well recognized. A better-refined knowledge of volcanic degassing mechanism and its interaction with the atmospheric environment can lead further to fill the persisting gaps in understanding well the impact of volcanic activities. The key is to monitor continuously the volcanoes at a global scale bearing also in mind the limitations of ground-based instruments during the ash-rich phase of emission. Thus, the space-borne sensors with a high spatial and temporal as well as spectral resolution are emerged but with complications in detecting low-altitude emissions, which are also limited to 12 h to 24 h of data acquisition frequency. Nonetheless, recently launched TROPOMI spectrometer onboard Sentinel 5P is shown to be a game-changer due to its high spatial and spectral resolution albeit the data acquisition frequency of only 24 h. To make further progress in retrieving high temporal SO_2 emission, the contemporary inverse modelling method has already been shown to be promising. The obtained modelled parameters, viz., SO_2 flux and altitude of injection, are reasonably compatible with the ground-based and space-borne observations [1] showing its importance in volcano monitoring [2] and towards forecasting large-scale plume dispersal [3]. The current work incorporates this advancing method and investigates a recent special volcanic event that occurred at Ambrym, Vanuatu during December 2018. The uniqueness of this eruption is the rapid shut down of decade long SO_2 degassing and lava lake just after the eruption with the emplacement of a major dike [4]. Here, the hourly retrieved SO_2 flux and altitude of injection are aimed to put to the fore the striking features of this unmonitored volcanic activity by assimilating the observations from several space-borne sensors.

To do so, the CHIMERE Eulerian chemistry-transport model (CTM) is used to simulate the Ambrym eruption at a large-scale during 13-19 December 2018. Weather Research and Forecast (WRF) model is used to force the meteorological fields in the CTM simulation, while ERA5 reanalysis data are used to force the initial and boundary conditions of the WRF simulation. The modelled SO_2 column amount is then co-located with the TROPOMI, OMPS and GOME2 SO_2 column amounts, respectively, to perform the inversion to estimate the modelled flux rates and altitude of injection. The high spatial and spectral resolution SO_2 data from TROPOMI is shown to reshape significantly the results obtained from the inverse method in comparison to OMPS and GOME2 SO_2 data. Furthermore, a proxy to the SO_2 flux is then developed from the geostationary

HIMAWARI data to validate the inversion results as the time resolution of HIMAWARI data acquisition is every 20 min. This work is further intended to explore more on the fate of sulphate aerosols formed during this eruption at a large-scale.

References:

1. Boichu et al., Atmospheric Chemistry and Physics, 15(14):8381–8400, July 2015.

2. Boichu et al., Atmospheric Chemistry and Physics, 13(17):8569–8584, September 2013.

3. Boichu et al., Geophysical Research Letters, 41(7):2637–2643, 2014.

4. Shreve et al., Scientific reports, 9(1):1–13, 2019.